A NEW FEATURE EXTRACTION TECHNIQUE FOR PERSON IDENTIFICATION

Inspiring Excellence

Supervisor: Dr. Jia Uddin

Shakib Muazzam	ID: 13101074
Tahsin Mohammad Ali	ID: 12241002
Md. Mehedi Hasan Shuvo	ID: 12101071
Nabid Kaisar	ID: 13101011

Department of Computer Science and Engineering,

BRAC University

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DECLARATION

We, hereby declare that this thesis is based on the results found by ourselves. Materials ofwork found by other researcher are mentioned by reference. This Thesis, neither in whole or in part, has been previously submitted for any degree.

Signature of Supervisor	Signature of Author
Dr. Jia Uddin	Shakib Muazzam
	Tahsin Mohammad Ali
	Md. Mehedi Hasan Shuvo
	Nabid Kaisar

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ABSTRACT

This paper proposes a one of a kind model of human distinguishing proof by which we can supplant the persevering work of individuals if there should arise an occurrence of security. Our technique is for the most part in view of human structure identification and face detection with Microsoft Kinect V1.0. With a specific end goal to apply our approach, 6 points of 20 in body structure and 26 points out of 121 in face detection is taken as input. These points are X, Y, Z coordinates outputted by Kinect skeletal and facial followingoutput by Kinect skeletal and facial tracking. 16 unique distances are then calculated by the Euclidean distance formula using the coordinates. These are the selective components extracted from each user and afterward put in a database. At long last, by coordinating calculation our framework distinguishes known or obscure users progressively. Final output is then given as a result with aptitude and noteworthy precision.

CHAPTER 01

INTRODUCTION

1.1 MOTIVATIONS

Every work has behind the scene story. Our work also has one. Today we want to see our world digitalized. We are trying to put technology in every angle of our life but sometimes few aspects are being missed where technology can be a great help. For example, a security guard is always on duty outside of ATM booths in our country. This same situation can be found in our loft structures or outside business office structures too. It is excessively tiring for an individual, making it impossible to carry out a vocation like this. So as to take care of this barbaric issue, we accompanied a thought which can supplant these employments with innovation using technology. A security system that can detect and identify particular human being by face and body structure detection from live video or from a depth image using Kinect.

1.2 CONTRIBUTION SUMMARY

In our proposed method, we have come up with a system which can identify human and give permission to the authorized person based on that person's face and body structuredetection using Kinect. Kinect can detect skeletal body points and face points. We are taking specific points which differ from human to human in both cases; body points and face points. 26 points from a human face and 6 points from body skeleton are being used here. We are calculating 13 distances in face and 3 distances in body and storing the input in a database. Then, whenever a person comes in front of the Kinect, it will again take those measurements from a human and compare the data withthe database to find out that which stored data gives the arithmetic difference, closest to zero. In the event that the system discovers anything like this, it will permit or else it won't permit the individual.

- ✓ Body point recognition.
- ✓ Body segment's length calculation.
- ✓ Face Detection points recognition
- ✓ Save both data in a database

1.3 THESIS ORIENTATION

Next parts are arranged in following orders:

- Chapter 2: BACKGROUND INFORMATION
- Chapter 3: Proposed Model
- Chapter 4: Experimental Analysis and Results
- Chapter 5: Conclusion and Future Work

CHAPTER 02

BACKGROUND INFORMATION

2.1 LITERATURE REVIEW

In Today's world, security is a vital matter in human life. Whatever you want to do in your life, security comes first. In order to make an efficient security system, a large number of researches are happening around the world. For example, D. Subhajit proposed a web based security system in his research. He proposed a system that will give real time security using internet of things (IoT) [11]. Moreover, Sudus K. E and Al Mamare S.H introduced a intelligent gate using image processing which will recognize the cars that are permitted to enter the building [1]. Furthermore, Philips J.P and Chellappa R. introduced a new biometric security system where finger prints and faces will be stored in database to compare during security check[7]. Another security system introduced by Kapur J. and baregar J. A. where cryptography, image steganography and image stitching are being used to design the system[3]. Last but not the least, Hossain B. Md. and Rahman S. M. created a security system which works basing on face detection and voice recognition[2]. Now, all those systems is either expensive to implement or has a loophole. For instance, voice can be replicated by other people. IoT based security systems are using network devices like Wi-Fi, Bluetooth devices which can get hacked. Furthermore, systems that are using fingerprints are also vulnerable to if anyone uses fake prints. To reduce these kinds of loopholes and to make a cost-effective system, we are introducing this system including body structure and face detection.

2.2 HARDWARE KNOWLEDGE

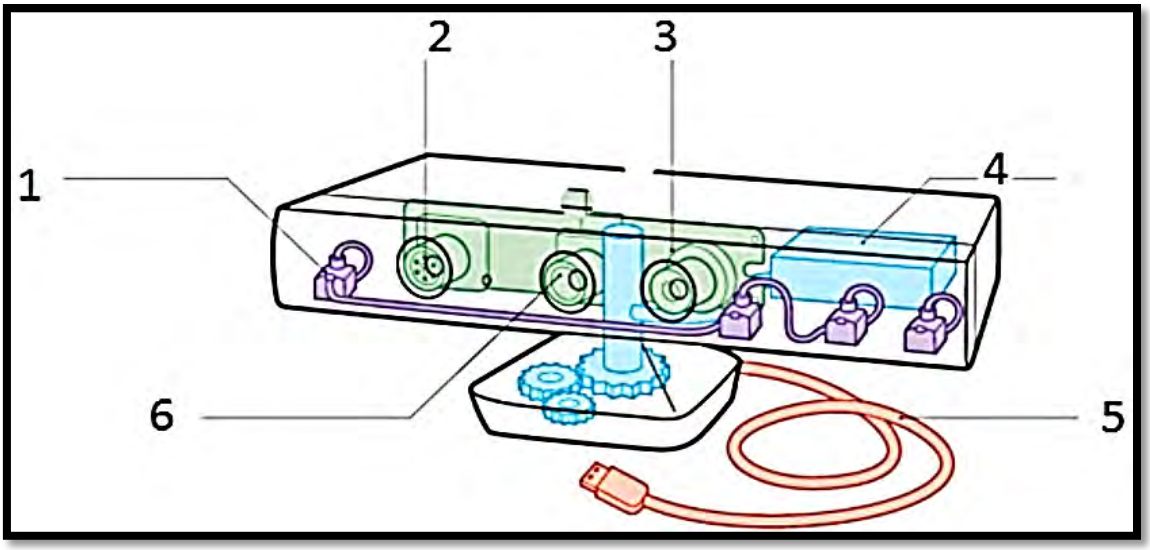
In this project, the main hardware component is Kinect (version 1). It was developed by Microsoft. Kinect (codenamed Project Natal during development) is a line of motion sensing input devices. Kinect V1 is a combination of Microsoft built software and hardware.

Kinect V1 hardware included a range chipset technology which consists of an infrared projector and camera and a special microchip that generates a grid from which the location of a nearby object in 3 dimensions can be ascertained.

The Kinect sensor contains many hardware that work as advanced sensor mentioned by Zeng W. **[12].** The Kinect sensor is a horizontal bar connected to a small base with a motorized pivot and is designed to be positioned lengthwise above or below the video display. The device features an RGB camera, depth sensor and multi-array microphone running proprietary software, which provide full-body 3D motion capture, facial recognition and voice recognition capabilities.

The depth sensor consists of an infrared laser projector combined with a monochrome CMOS sensor, which captures video data in 3D under any ambient light conditions. The sensing range of the depth sensor is adjustable, and Kinect software is capable of automatically calibrating the sensor based on movement and the physical environment, accommodating for the presence of furniture or other obstacles.

Kinect is capable of simultaneously tracking up to six people. In Figure 1, a detailed



picture of Kinect is given.

FIGURE 1:KINECT WITH KEY COMPONENTS(1.MICROPHONE ARRAY, 2. IR EMITTER, 3. DEPTH CAMERA, 4. TILT MOTOR, 5. USB CABLE, 6. COLOR CAMERA)

2.3 SOFTWARE KNOWLEDGE

We used a variety of software to complete our project. We largely used the Kinect SDK. Native face detection and skeleton detection tools of Kinect SDK was used[4][6].We took that result in a text file for each person and then we did plotting and calculations from that-producing an output.

To take desired input data, Microsoft visual studio was used with our own tweaks in the source code of Microsoft Kinect SDK tools. Microsoft visual studio has the full language support for Kinect version 1 which is widely based on C# and C++. Eclipse with OpenGL/JOGL library was used for plotting face and body points. NetBeans IDE based Java Programming was used to perform different calculations.

CHAPTER 03

PROPOSED MODEL

3.1 INTRODUCTION

Figure 2 has shown the detailed work flow of our proposed model. Our proposed model consists of three parts. They are Initialization, Input and last part is Matching and Results. The main purpose of our system is to identify an authorized or unauthorized person from his or her face and body points. To detect face and body points, we used Kinect. It can easily detect body points and face points.Initially Kinect helps us to get 20 joints in body parts and 121 points in face, said by Pterneas V[8].The distance between various points can also be measured easily by the input coordinates. 16 distances in total are calculated; 13 from face and 3 from body, are being used in the model to identify a person. After that, we stored those in database and compare them with thereal-time data that we will get again from a person, who will come in front of the Kinect in the specific position. If the new data difference with any of the data from database is close to zero, that person will be authorized by our system for entry. The main object is to give human race a promising system which will be very hard to manipulate and will give maximum security with substantial accuracy.

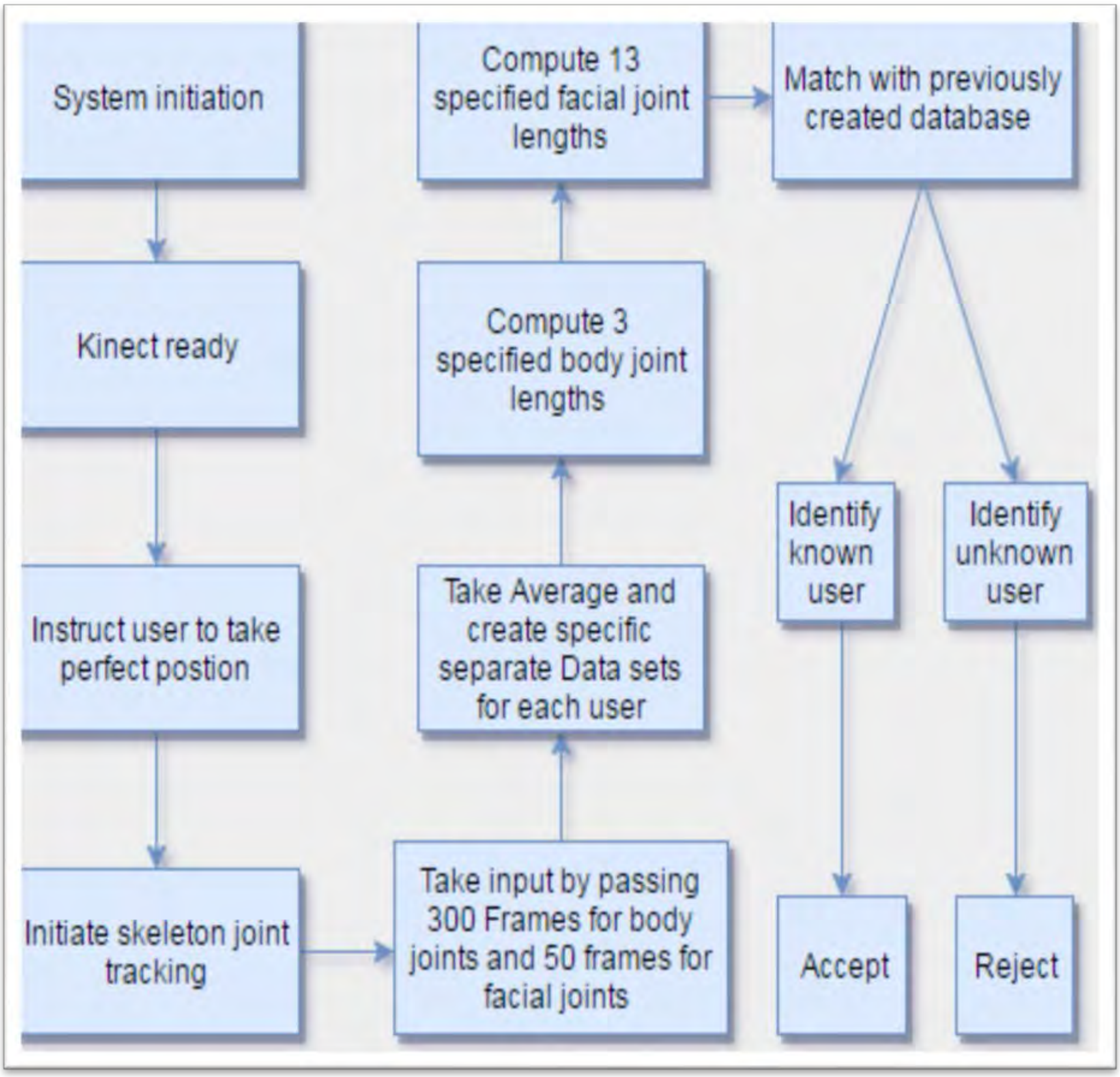


FIGURE 2: WORK FLOW DIAGRAM

To do the operation, a person has to:

- ✓ Stand in front of Kinect for a certain period of time at a specific position
- ✓ His or her data will be stored in database
- ✓ That person needs to stand at least at a distance of 3 meters

By playing out these means effectively, our system can provide the best possible security.

3.2 INITIALIZATION

Initialization in this project is very important part. Setup of Kinect is very important for our proposed model. In order to give this a proper solution, we maintained certain things to before starting our experiment.

First of all, we kept the Kinect at 1m above from the ground as shown in Figure 2.Secondly, the person whose body and face joint will be taken should stand at a distance of 3m from the Kinect.

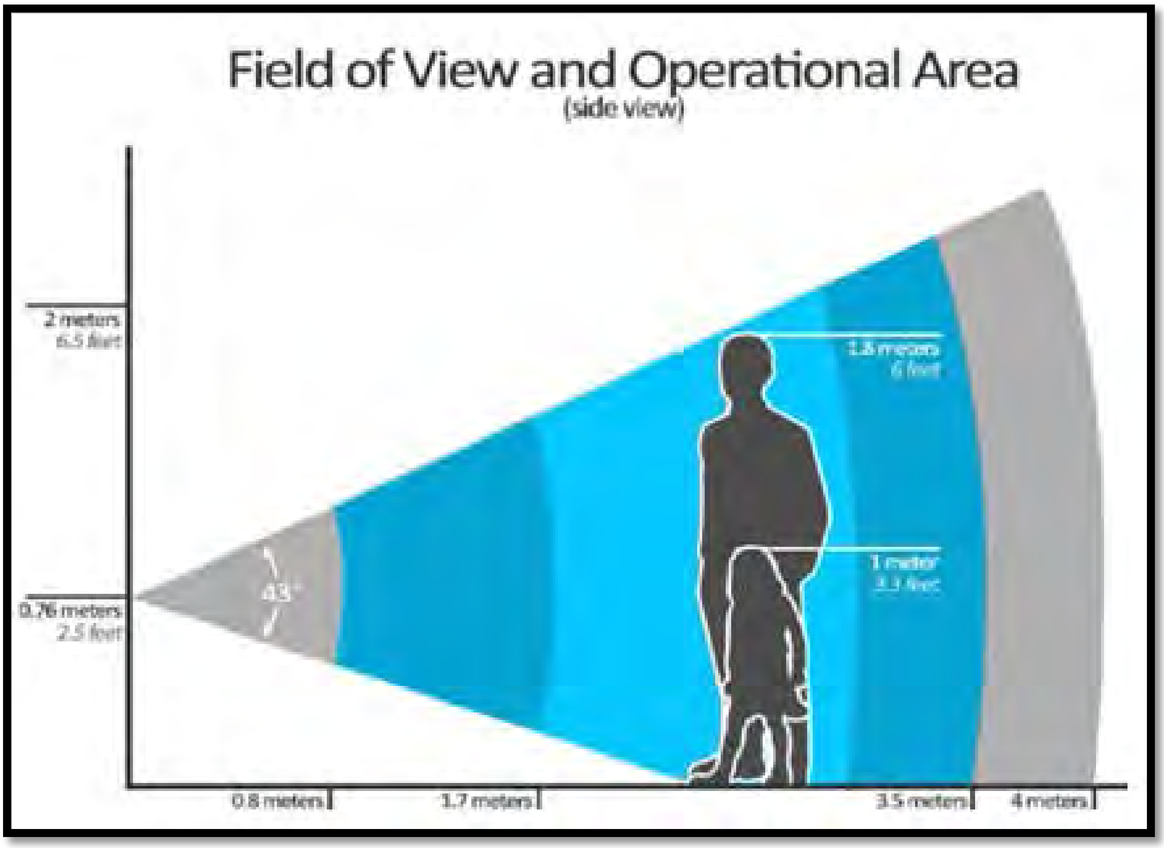


FIGURE 3: KINECT POSITION SETUP

Finally, when a person stands in front of the Kinect, it scans his body including face and take measurement of 3 joints in body and of 13 joints from face with 300 frames and 50 frames. We took the average of those frames in each case.

In the last we saved the information of 16 distances in database for later compare and calculation.

3.3 INPUT

Kinect sends 30 to 32 frames for each second (Kinect for windows) **[5]**. But in our project, we got 300 frames from Kinect. Sometimes Kinect gave us 302 frames because of fast calculation. We took all the 300 or 302 frames for calculating body joints. In case of face, we took 50 frames exactly and took all frames to measure the necessary 13 joints of face.

Finally, we took the average of 300 frames for each joint and average of 50 frames for each joint and store them in database for later use for matching.

Here we are taking 2 sets of data for each time (body and face) just to see the fluctuation rate. We saw that, it does not differ so much.

We used set 1 data for using it in our experiment.

3.4MATCHING AND FINAL OUTPUT

In this part, we did not used any matching algorithm for identification. Rather we used a simple method to identify the person. After storing all data, if any person comes in front of Kinect, it will take necessary body point and face point measurement. But this time the system will not store it in database.Without storing it in database, the system will subtract the points from the value stored in the database.The system will subtract the 3 distance value of body from the data already stored in database. This same action will happen in case of face where we took 13 distances from 26 points.

Next, the system will perform a additive action where it will add the three subtraction value of body point distances and 13 subtraction value of face point distances.

Now, system will check from which data from database, the new data difference is less which means nearly close to zero. If that person's data is stored already, then his difference will be close to zero from the value previously stored. If it is not, then value will be far from zero.

Finally, if the data is stored already and system finds its difference from the stored data close to zero, then it will show that the person is authorized. If it is not, then the system will show the negative and will not allow the person.

CHAPTER 04

EXPERIMENTAL RESULTS AND ANALYSIS

In order to implement the proposed model some hardware and software setup is needed, after setting up all thenecessary things implementation will be started. In thissection, full description of experimental setup will be described.

To implement our proposed model, we setup an experiment using Kinect developed by Microsoft, which can detect human from their various skeleton information.

In order to make a Kinect a usable camera for our security system, we used Microsoft Visual studio. In our experiment, Visual studio 2010 is used. The reason behind the use of Microsoft Visual studio is it can easily manipulate C# language as it has Integrated Development Environment (IDE) which can support full language for Kinect. Here we used Kinect v1.0.

4.1 CALCULATING BODY SEGMENT LENGTH

In the body section, we took 6 point. These six points are giving us 3 distance.

For calculation X, Y, Z coordinate value is must. Here,

- ✓ X coordinate indicates the position across the X axis
- ✓ Y represents the height of user from Kinect
- ✓ Z represents the distance of user from Kinect

After getting all three-coordinate data, we are using following formula to calculate the distance[10].

$$\sqrt{(X1 - X2)^2 + (Y1 - Y2)^2 + (Z1 - Z2)^2}$$

In this context, X1, Y1 and Z1 are the coordinate value of first point and X2, Y2 and Z2 is the coordinate value of second point.

Using this formula in body skeleton, we got three distances. Those are as follows:

- ✓ Head to Abdominal
- ✓ Right shoulder to left shoulder
- ✓ Lower right abs to left abs

In figure 4, we will show the points and distances we have taken.

We took two sets of data just to check the how much the values vary each time. We found that the difference is not significant.

TABLE 1: HUMAN BODY POINTS (SET-1)

User	USER 1	USER 2	USER 3	USER 4	USER 5
Head to Abdominal	126.28	144.15	122.21	134.11	135.62
Right shoulder to left shoulder	62.45	78.54	65.28	77.88	73.14
Lower right abs to left abs	29.29	37.04	30.49	36.66	34.06

TABLE 2: HUMAN BODY POINTS (SET-2)

User	USER 1	USER 2	USER 3	USER 4	USER 5
Head to Abdominal	127.01	143.3	123.34	132.16	136.41
Right shoulder to left shoulder	62.61	79.71	66.58	78.71	71.98
Lower right abs to left abs	29.49	37.25	31.33	37.08	33.81

Table 1 and Table 2 are the 2 data sets of body points of our experiment. Both set were taken to check difference. Here, we can see difference is not that much. For experiment, set 1 was used.

FIGURE 4: BODY POINTS

In Figure 3, the red dots are the six points we have taken. The yellow and white lines indicate the distance we have measured.

4.2 CALCULATING FACE SEGMENT LENGTH

In face detection, we took 26 points. From these points, we are getting 13 distances. In this case also we measured the X, Y, Z value of each coordinate. Then, we used the previously mentioned formula again to measure the distance. The formula is:

$$\sqrt{(X1 - X2)^2 + (Y1 - Y2)^2 + (Z1 - Z2)^2}$$

In face detection, it was difficult to name each and every 13 distances we took. So, we marked them with numbers in the order it appears in Kinect.

The numbers will be shown in figure 7.

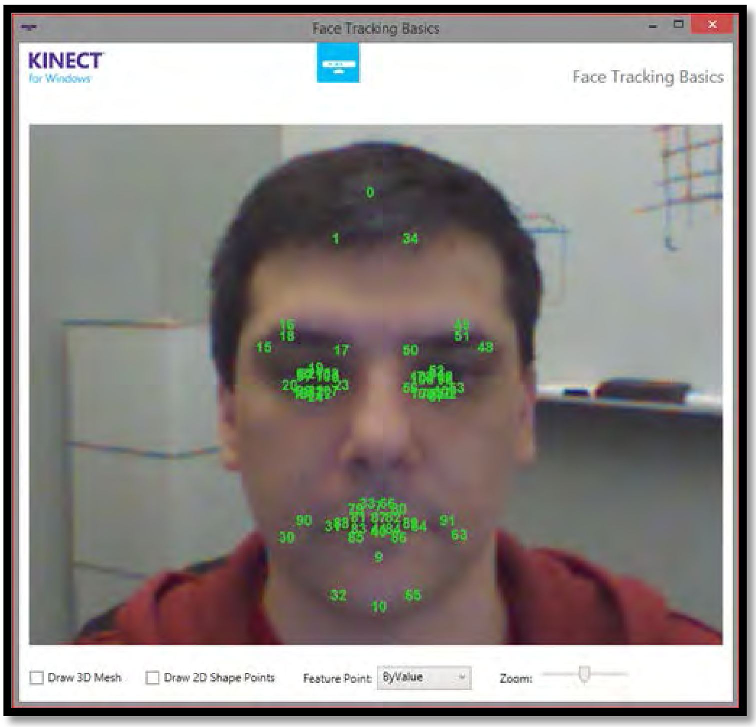


Figure 5: ALL 121 POINTS GIVEN BY KINECT

We did the same as body. We took two sets of data just to check the difference. Here, we saw again that the difference is not remarkable. After calculating the data, we stored them in database for later calculation.

In Figure 5, all 121 face points are shown which are given by Kinect. Among these121 points, 26 points are taken for performing the experiment. These 26 points providing 13 distance which differ from person to person.

FIGURE 6: 26 POINTS ON FACE FROM 121 POINTS

Figure 6, illustrates those 26 points which are taken among 121 points. These 26 points are being used in experiment to distinguish between persons by measuring 13 distances.

Now, the two sets of data table will be given below which are as follows:

TABLE 3: FACE POINTS 13 DISTANCES (SET 1)

User	User 1	User 2	User 3	User 4	User 5
Distance from 0 to 10	86.58	104.4	96.42	116.51	133.11
Distance from 90 to 91	33.56	37.2	35.15	45.37	47.67
Distance from 65 to 32	17.52	18.93	18.1	22.89	25.24
Distance from 64 to 31	20.23	23.36	21.69	29.96	27.41
Distance from 85 to 81	1.94	3.53	3.15	5.56	2.74
Distance from 40 to 87	-0.79	0.62	0.43	3.2	-2.01
Distance from 86 to 82	2.1	3.44	3.24	5.7	2.8
Distance from 17 to 15	20.56	21.79	22.63	26.81	29.08
Distance from 23 to 20	16.08	18.19	18	21.91	23.21
Distance from 48 to 50	21.96	22.48	19.46	24.54	30.58
Distance from 53 to 56	16.89	18.51	16.34	20.72	23.99
Distance from 18 to 16	2.53	2.86	2.71	3.32	3.76
Distance from 51 to 49	2.53	2.86	2.68	3.29	3.77

In Table 3, the first set of 13 face point is given. These 13 sets are used in the experiment. The second set is taken to check how the values differ from one another when Kinect take input again of same persons.

TABLE 4: FACE POINTS 13 DISTANCES (SET 2)

User	User 1	User 2	User 3	User 4	User 5
Distance from 0 to 10	88.12	103.5	97.07	116.63	133.72
Distance from 90 to 91	33.8	36.94	36.04	44.16	47.32
Distance from 65 to 32	17.87	18.94	18.24	23.09	24.61
Distance from 64 to 31	19.72	22.82	23.34	26.6	28.75
Distance from 85 to 81	1.44	3.44	3.27	4.61	5.96
Distance from 40 to 87	-1.61	0.44	0.93	1.25	2.54
Distance from 86 to 82	1.62	3.36	3.53	4.74	6.07
Distance from 17 to 15	21.75	22.24	22.43	28.88	27.75
Distance from 23 to 20	16.45	18.23	18.28	22.23	22.39
Distance from 48 to 50	23.03	22.57	18.17	26.17	29.23
Distance from 53 to 56	17.25	18.38	16.23	20.76	23.13
Distance from 18 to 16	2.59	2.85	2.73	3.35	3.54
Distance from 51 to 49	2.59	2.86	2.7	3.31	3.56

TABLE 4 is second set. Comparing both set, it can be concluded that every time Kinect take inputs, it may differ from previous value but that is not remarkable.

To illustrate the distance more clearly, a Figure is also given below which is as

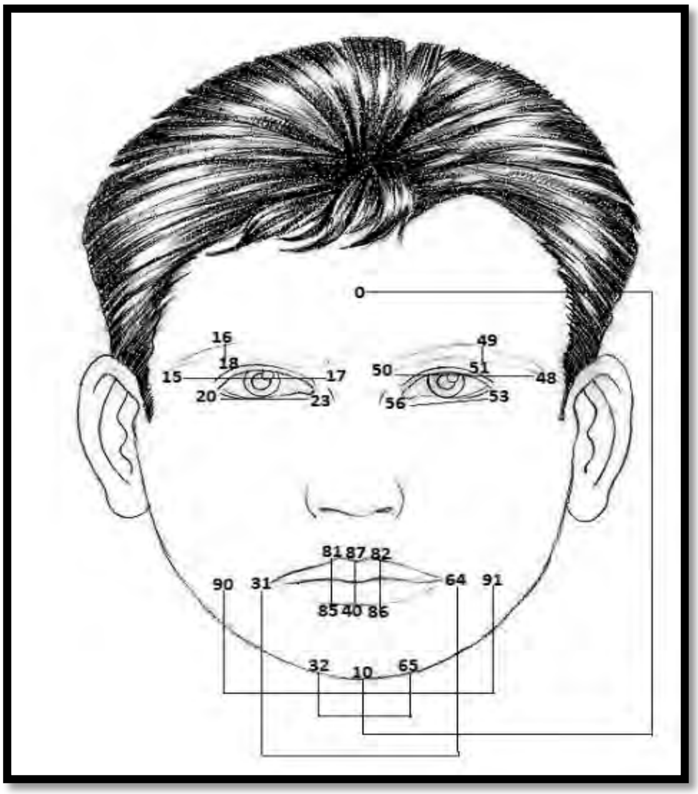


Figure 7: FACE POINTSDISTANCES

In Figure 7, the lines indicate the distances between the points. Here, 13 distances have been shown which are taken to measure for security system.

Now, the comparing part will be described which are as follows:

- ✓ Storing those in database
- ✓ New person comes in front of Kinect
- ✓ Kinect took the data of body points
- ✓ Again, we took the data of face points
- ✓ Calculate the distance for both case
- ✓ Now subtract from stored data in both case
- ✓ Then add the value of subtraction
- ✓ Check the result
- ✓ If it is close to zero, then authorize
- ✓ If it is not close, then restrict

4.3 RESULT AND COMPARISON:

TABLE 5:Result (BODY)

Person	Difference
USER 1	1.09
USER 2	42.24
USER 3	9.11
USER 4	29.92
USER 5	24.18

TABLE 6: Results (FACE)

Person	Difference
USER 1	7.55
USER 2	107.53
USER 3	85.16
USER 4	34.65
USER 5	24.34

To calculate these results, we only used date set 1 for both case face and body points distance calculation. In Table 5 for user 1, the difference is less than 5 and in table 6, that is less than 10. So, User 1 is authorized.

Biometric Technology	Accuracy	Cost	Devices required	Social acceptability
ADN	High	High	Test equipment	Low
Iris recognition	High	High	Camera	Medium-low
Retinal Scan	High	High	Camera	Low
Facial recognition	Medium-low	Medium	Camera	High
Voice recognition	Medium	Medium	Microphone, telephone	High
Hand Geometry	Medium-low	Low	Scanner	High
Fingerprint	High	Medium	Scanner	Medium
Signature recognition	Low	Medium	Optic pen, touch panel	High

Figure 8: Other models of security system

Figure 8, illustrates the other security systems accuracy, cost, device requirement and social acceptability [13]. Comparing to those systems, the proposed model in our paper is:-

- Cost efficient and effective.
- This system is commencing double check on every person depending on unique features with their skeletal points for both body and face.
- Accuracy as shown on table 5 and 6, is moderately quite high.
- Cost is comparatively low because the system only needs a Kinect as a hardware and either an existing PC or a raspberry pi.

CHAPTER 05

CONCLUSIONS AND FUTURE WORKS

5.1 CONCLUSION

This entry restrictingsecurity system is exceptionally successful for each place where security is a crucial concern. It can be utilized as a part of fundamental door security of our home, outside ATMs, in entryways of schools, universities, colleges, workplaces, banks and numerous more places. Presently a-days security is critical yet we ought to make it simple have not difficult for others. We think our security system will lessen the agonizing work of security gatekeepers remaining outside our homes, workplaces, ATMs and so forth and will make a safe and secured condition for everybody in a proficient and cost effective way.

5.2 FUTURE WORKS

Most importantly, our lady goal is to utilize this security system in those spots where watches/guards work from day to night with no break for giving us security which is our home.

After that we can likewise utilize this system for banks, commercial premises, Govt. workplaces or some other association. It can be applied for permitted individual to enter in the workplace. We will likewise track the substance of those individuals who were dismissed by the system to enter. The image of the unauthorized person will be saved in the authorized person's computer for further security purpose.

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